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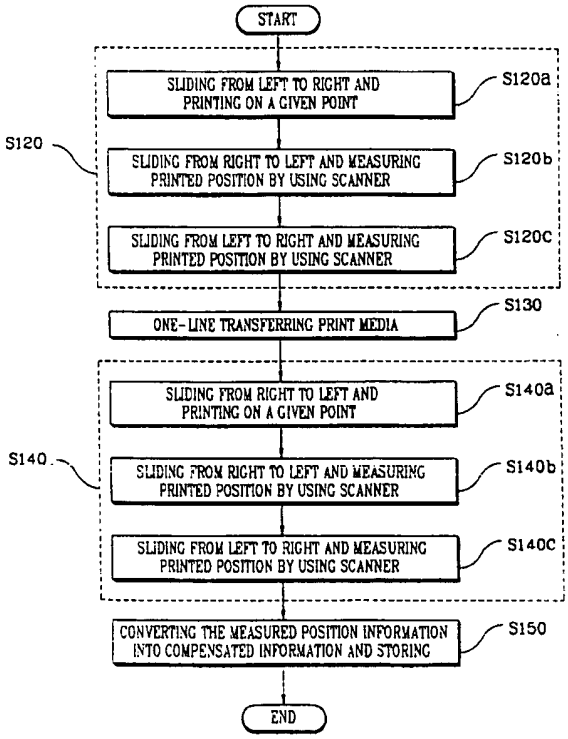
(54) Position compensating method during two-way printing and scanning

(57) A method of compensating for errors in scanned data is described. A pattern is printed on a record sheet using a bi-directional printer head. The printed pattern is then scanned from the record sheet using a bi-directional scanner. Error compensation factors are calculated from the bi-directionally scanned data, to be applied to subsequently scanned image data to compensate for a bi-directional position error of the scanned image data.

FIG. 2



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Description

BACKGROUND TO THE INVENTION

The present invention relates to a position compensating method during two-way printing and scanning. More particularly, it relates to a position compensating method for a multi-tasking system having for example an ink-jet print head and a shuttle scanner.

Multimedia systems, combinations of moving and still pictures, sound, music and words, especially in computers or entertainment are pervasive in the industrialised world. In line with the development of a multimedia computer system, printers, being one kind of peripheral device, have become multi-functional.

A multi-tasking system having printing and scanning functions will now be described referring to the attached drawings. The multi-tasking system having printing and scanning functions receives/outputs data and/or control signals from/to an external system through an interface 21. Data to be printed is transmitted from personal computer 10 to a central processing unit (CPU) 23 through interface 21. CPU 23 that receives the data to be printed reads out a necessary control program and data through a memory 22, and produces a control signal to a print driver 24. Print driver 24 controls the printing mechanism in response to an applied control signal, thus performing printing.

A shuttle scanner is used to scan the document on which the information is recorded. When the information of the document is scanned through the shuttle scanner, an image processor 26 compensates scanned image data and stores it in image memory 28. The image data, stored in image memory 28, is transmitted to a personal computer (PC) 10 through interface 21 under the control of CPU 23. PC10, receiving the image data via interface 21, processes the image data and stores it as a database. In order to print the scanned data, data to be printed is produced again to a multi-tasking system 20. Multi-tasking system 20 generates a control signal to CPU 23, and image data is printed out on a print media through print driver 24 and print mechanism 25.

The conventional multi-tasking system prints a certain printer pattern in order to measure a print compensating value during two-way printing so that a user can examine the printing state with the named eye. The multi-tasking system employs different methods of measuring a print compensating value by sets and the print compensating value varies with the time.

In a multi-tasking system employing an ink-jet print head, the print compensating value varies with the amount of ink used, and the user has to change the print compensating value frequently. A print compensating value should be changed for each set of the multi-tasking system in the manufacturing process.

SUMMARY OF THE INVENTION

According to the present invention, a method of compensating for errors in scanned data comprises:

printing a pattern on a record sheet using a printer head which moves in a first direction;

scanning the printed pattern from the record sheet using a bi-directional scanner which moves in the first direction and the opposite direction; and

calculating from the bi-directionally scanned data an error compensation factor to be applied to subsequently scanned image data to compensate for a bi-directional position error of the scanned image data.

The printer head may be an ink-jet print head and may be a bi-directional printer head adapted for bi-directional printing operations. Preferably, the pattern is printed in such a bi-directional printing operation.

The bi-directional printing operation may comprise:

printing a first part of the pattern moving the printer head in the first direction;

advancing the record sheet; and

printing a second part of the pattern moving the printer head in the opposite direction.

Preferably, the direction in which the record sheet is advanced is substantially normal to the first and opposite directions.

The method may comprise:

printing the first part of the pattern;

bi-directionally scanning the first part of the printed pattern from the record sheet;

advancing the record sheet;

printing the second part of the pattern;

bi-directionally scanning the second part of the printed pattern from the record sheet; and

calculating from the bi-directionally scanned data a number of error compensation factors to be applied to subsequently scanned image data to compensate for a bi-directional position error of the scanned image data.

Preferably, the pattern is one or more vertical lines.

The present invention also provides a combined printer and scanner comprising:

a printer head;

a scanner; and

control means for causing the printer head to print a pattern on a record sheet moving in a first direction, for causing the scanner to scan the printed pattern from the record sheet bi-directionally by moving in the first direction and the opposite direction and for calculating from the bi-directionally scanned data an error compensation factor to be applied to subsequently scanned image data to compensate for a bi-directional position error of the scanned image data.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

The present invention will now be described by way of example with reference to the accompanying drawings in which:

FIG.1 is a block diagram of an internal circuit for an ink-jet printer with a conventional shuttle scanner;

FIG.2 is a control sequence of a position compensating method during two-way printing and scanning in accordance with the present invention; and

FIG.3 depicts an ink-jet printer mechanism having a shuttle scanner in accordance with the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

As shown in the drawings, the position compensating method includes an initialising step S110 for compensating a print position; a first step S120 of sliding ink-jet printer head 270 from left X' to right X once it is ready to compensate a print position in S110, printing a given point P, scanning in two directions, and then measuring a printed position; a second step S130 of one-line transferring a print media 1 for printing inn an opposite direction once the first step S120 is completed; a third step S140 of measuring a print position, sliding ink-jet print head 161 from a right X to left X' if the second step S130 is completed, scanning a given point in both directions, and then measuring the printed way printing and scanning is more fully described as follows.

Once data to be printed is transmitted to the multi-tasking system from a personal computer (not shown), a control signal according to the print operation is generated in order to process the data to be printed as follows.

In the first place CR motor 110 that controls the rotation according to the control signal, transmits the rotating force to belt 130 through a pulley 120. Ink-jet print head 161 is slid along the width of the print media by the force transmitted to belt 130. Ink-jet print head 161 is moved under the guidance of a guide shaft 150. Ink-jet print head 161 sprays the ink onto print media 1 in response to the control signal.

Once a user places the document on the multi-tasking system for scanning, the document is scanned by shuttle scanner 162. Shuttle scanner 162 which scans the information recorded on the document is mounted on one side of ink-jet print head 161, and moves along with ink-jet print head 161 along guide shaft 150 by the rotating force of CR motor 110. The scanned image data is stored by the use of the PC10 as a database, or processed in PC10 according to an application program..

There is a difference between an actual print position during printing and a print position computed in the application software because of the printer mechanism's inertia or backlash and the time it takes for the ink or dot wire from the ink-jet print head to reach print media 1.

The difference becomes double during two-way printing or two-way scanning, and value used to assure the best possible print quality and the scanning quality is compensated by software.

For such a compensation, ink-jet print head 270 of first step S120 is slid from X' to right X, and performs a step S120a for the print operation on a given point P of print media 1.

Once printing is performed in a constant pattern on given point P of print media 1, scanner 162 is slid from right X to Left X' to scan the printed position on print media 1(S120b). A value of the scanned point equals "Y_{r1}". If "Y_{r1}" is computed, scanner 162 is slid from left X' to right X, through scanning and performs step (S120c) that measures printed position.

If is computed, scanner 162 is slid from left X' to right X, through scanning and performs step (S120c) that measures printed position.

If "Y_{r1}" is computed after changing the printing direction, print media 1 is one-line transferred (S130) for printing in the opposite direction. If one line of print media 1 is transferred (S130), third step S140 and step S140a are performed so that ink-jet print head 161 is slid from right X to left X', thereby printing on print media 1 that has been one-line transferred.

Once printing on one-line transferred print media 1, scanner 162 is slid from right X to left X', to measure the printed position (S140b) through scanning. The value of the printed position is "Y_{r1}". Once the value of the printed position is "Y_{r1}" is computed, scanner 162 is slid from left X' to right X to perform step 140c, thus measuring the printed position by scanning in the opposite direction. This scanning position is "Y_{r11}". When each value of the printed position "Y_{r1}", "Y_{rr}", "Y_{r1}", "Y_{r11}" is produced through the above step, it is converted into print position compensating information (S150), thus processing the print position compensating information.

The following reference letters denote the following

reference things:

Em - Error made by print mechanism

Eh - Error by ink-jet print head

EsS - Error by photo-accumulating time

Em + EH - Position error between print position in software and actually printed position Em + Es - Error between actually printed position and position of scanned data. Once setting such an error value, the position error equals 2 * (Em _ Eh) during two-way printing, and the position error equals 2 * (Em + Es) during two-way scanning. Accordingly, the two-way print position compensation is expressed as follows:

$$|Y_{rr} - Y_{r1}|/2 \text{ or } |Y_{rr} - Y_{11}|/2 = Em + Es \quad 1$$

$$Y_r = (Y_{rr} - Y_{r1})/2 \quad 2$$

$$Y_1 = (Y_{1r} + Y_{11})/2 \quad 3$$

$$|Y_r - Y_1|/2 = Em + Eh \quad 4$$

The information of two-way printing position compensation is output according to equations 1 to 4. A difference between the middle position of two-way print position on print media 1 and position computed by software corresponds to a distance between ink-jet print head 161 and scanner 152, so

$$|Y_r - Y_1|/2\text{-}X = dh + ds \quad 5$$

the information of scanner's position error compensation is output through equation 5. At this point, "dh" is a distance Ph between carrier 160's position PC and ink-jet print head 161 mounted on carrier 160, and "ds" is a distance Ps between position Pc of carrier 160 of the multi-tasking system and scanner 162's. Once two-way printing and scanning position compensation information are computed through this step, outputting the position information is completed through step S160. Once the position compensation information is output, it is stored in the memory (not shown) of the multi-tasking system. Thus, as two-way printing operation and scanning operation are completed, the measured data is converted into position compensation information to be utilised during the two-way printing operation and scanning operation. As described above, the present invention automatically measures and compensates the position error whenever the printing function of the multi-tasking system is used, so that the user may use the printing function more conveniently, and the number of the manufacturing steps for controlling the print position is decreased, thus enhancing the manufacturing efficiency.

Claims

1. A method of compensating for errors in scanned data comprising:

   printing a pattern on a record sheet using a printer head which moves in a first direction;

   scanning the printed pattern from the record sheet using a bi-directional scanner which moves in the first direction and the opposite direction; and

   calculating from the bi-directionally scanned data an error compensation factor to be applied to subsequently scanned image data to compensate for a bi-directional position error of the scanned image data.

2. A method according to claim 1 in which the printer head is an ink-jet print head.

3. A method according to claim 1 of claim 2 in which the printer head is a bi-directional printer head adapted for bi-directional printing operations.

4. A method according to claim 3 in which the pattern is printed in such a bi-directional printing operation.

5. A method according to claim 4 in which the bi-directional printing operation comprises:

   printing a first part of the pattern moving the printer head in the first direction;

   advancing the record sheet; and

   printing a second part of the pattern moving the printer head in the opposite direction.

6. A method according to claim 5 in which the direction in which the record sheet is advanced is substantially normal to the first and opposite directions.

7. A method according to claim 5 comprising:

   printing the first part of the pattern;

   bi-directionally scanning the first part of the printed pattern from the record sheet;

advancing the record sheet;

printing the second part of the pattern;

bi-directionally scanning the second part of the printed pattern from the record sheet; and

calculating from the bi-directionally scanned data a number of error compensation factors to be applied to subsequently scanned image data to compensate for a bi-directional position error of the scanned image data.

8. A method according to any preceding claim in which the pattern is one or more vertical lines.

9. A method of compensating for errors in scanned data as described with reference to and as illustrated in FIGs. 2 and 3 of the accompanying drawings.

10. A combined printer and scanner comprising:

a printer head;

a scanner; and

control means for causing the printer head to print a pattern on a record sheet moving in a first direction, for causing the scanner to scan the printed pattern from the record sheet bi-directionally by moving in the first direction and the opposite direction and for calculating from the bi-directionally scanned data an error compensation factor to be applied to subsequently scanned image data to compensate for a bi-directional position error of the scanned image data.

FIG. 1

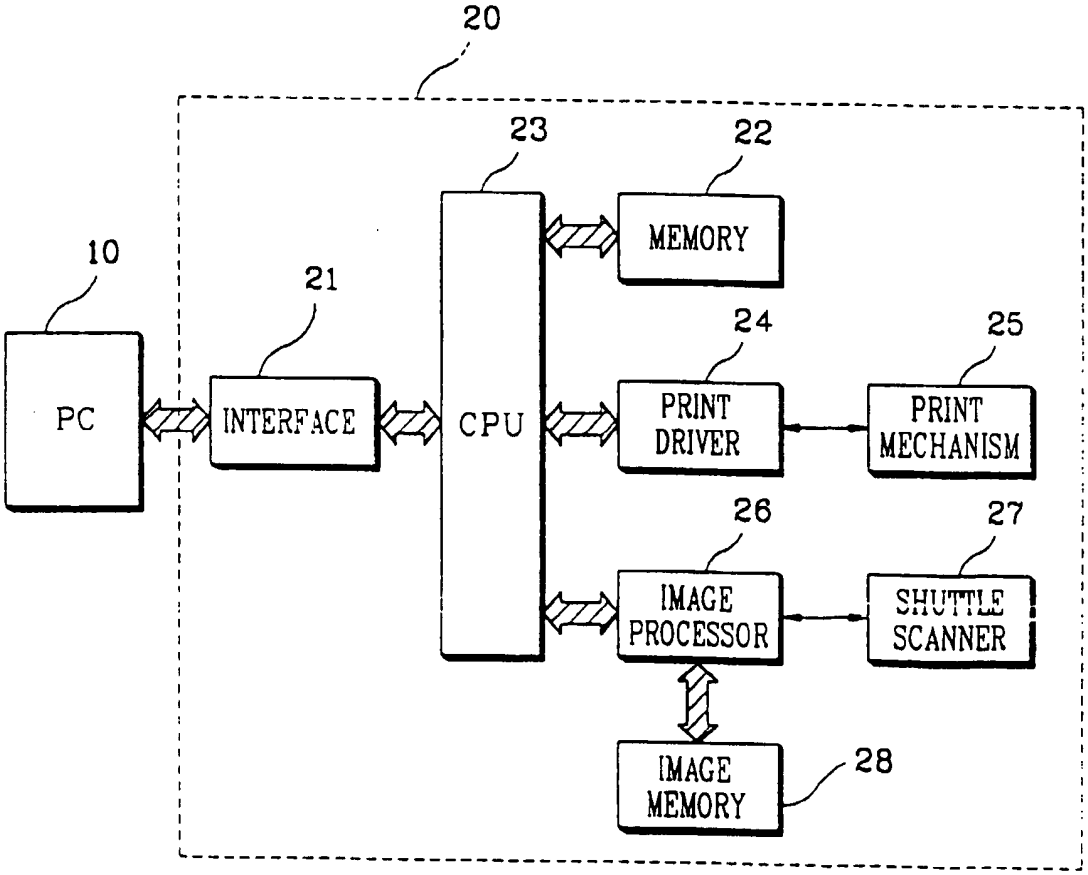
20
23
22
MEMORY
10
21
24
25
PC
INTERFACE
CPU
PRINT DRIVER
PRINT MECHANISM
26
27
IMAGE PROCESSOR
SHUTTLE SCANNER
IMAGE MEMORY
28

FIG. 2

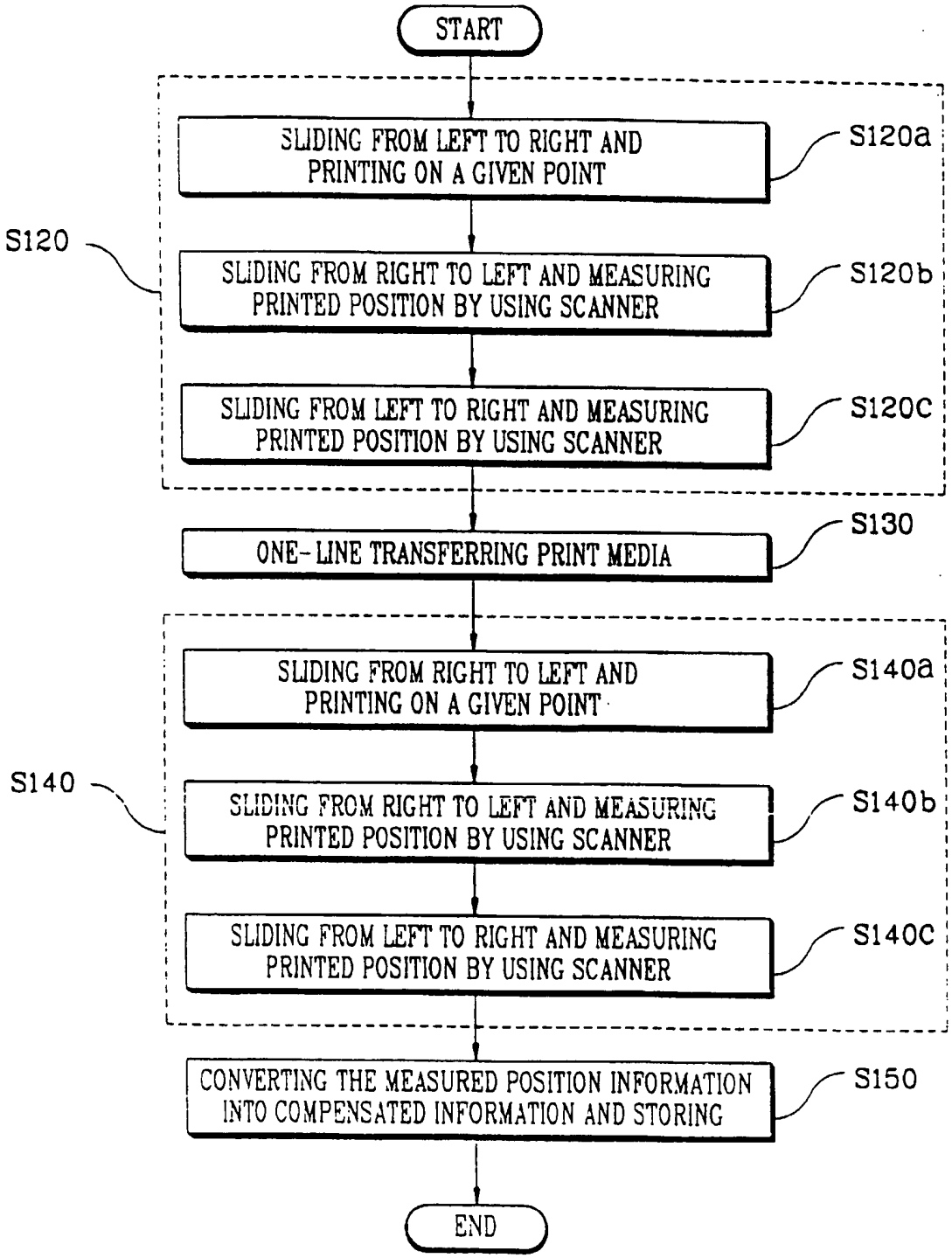
START
SLIDING FROM LEFT TO RIGHT AND PRINTING ON A GIVEN POINT
S120a
S120
SLIDING FROM RIGHT TO LEFT AND MEASURING PRINTED POSITION BY USING SCANNER
S120b
SLIDING FROM LEFT TO RIGHT AND MEASURING PRINTED POSITION BY USING SCANNER
S120c
ONE-LINE TRANSFERRING PRINT MEDIA
S130
SLIDING FROM RIGHT TO LEFT AND PRINTING ON A GIVEN POINT
S140a
S140
SLIDING FROM RIGHT TO LEFT AND MEASURING PRINTED POSITION BY USING SCANNER
S140b
SLIDING FROM LEFT TO RIGHT AND MEASURING PRINTED POSITION BY USING SCANNER
S140c
CONVERTING THE MEASURED POSITION INFORMATION INTO COMPENSATED INFORMATION AND STORING
S150
END

FIG. 3